مفاهيم الأحياء (إنجليزي)

الصف الثالث الثانوي

Summary CH. (1) Support and movement in living organisms

Support in the plants

1- Physiological support Due to the presence of water in the cell vacuoles
2- Structural support Due to the presence of deposition of some materials on the cell wall

The human skeletal system

The human skeletal system consists of skeleton ,cartilage, joints, ligaments and tendons.

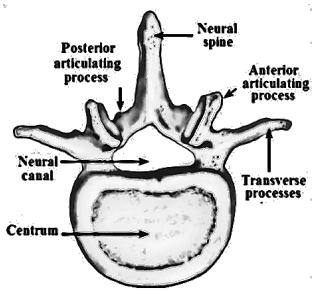
Firstly: The skeleton

It is divided into **Axial** skeleton and **Appendicular** skeleton .

The Axial skeletal system (Vertebral column - Skull - Thoracic cage)

1) The vertebral column (33 vertebrae)

Name	Location	Size	No.
Cervical	Neck region	Moderate	7
Thoracic	chest region	Large	12
Lumber	Abdominal region	The biggest	5
Sacral	Below lumber	Broad, flat& fused	(5)
Coccyx	Below sacral	Small& fused	(4)

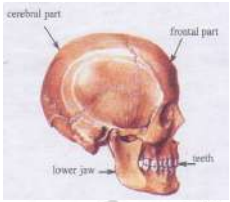


(Fig.2) The bony vertebra

Structure of the vertebra:

It is formed of an anterior thick part called Centrum, at both sides of the Centrum there are two transversal processes, at the dorsal side of the Centrum there is a ring bone called neural arc, through which the spinal cord runs and carries a neural spine.

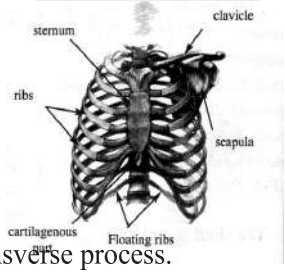
2) The skull (Cranium)



It is formed of 2 main parts **1- The cerebral part** consists of 8 bones connected together at the outer part by sutures and contains a big foramen (hole) through which the spinal cord is connected to the brain.

2. The facial part includes facial bones, the two jaws, and the positions of sense organs

3) The thoracic cage



It is formed of 12 thoracic vertebrae, sternum & 12 pairs of ribs.
All the 12 pairs of ribs are connected to the thoracic vertebra posteriorly.
The upper 10 pairs only are connected to the sternum anteriorly,
but the two lower pairs are short and do not reach the sternum so, they called floating ribs.

The sternum is a flat bone pointed at its lower part, is cartilage.

The rib is a curved bone attached to the vertebra at its centrum &its transverse process.

The ribs move by the help of the intercostal muscles interiorly & laterally to increase the thoracic cavity during inhalation and vice versa during expiration..

The Appendicular skeletal system

(Two Girdles (Pectoral & Pelvic) and four limbs

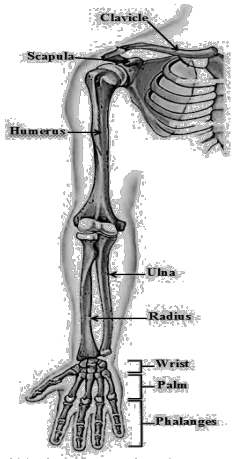
The Pectoral girdle (Shoulder) consists of two identical halves, Each half consists of scapula and clavicle bone.

Scapula is a triangular bone, its inner end is broad, the outer end is pointed, the scapula has a cavity called glenoid cavity to form shoulder joint with the fore limbs.

The fore limbs

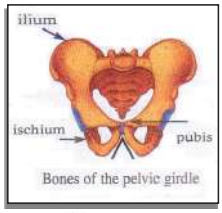
Each fore limb has ***The Upper arm*** (humerus) and ***Lower arm*** (radius and ulna).

☝ The humerus fits in a depression of the ulna,
The radius is smaller and rotates round the fixed ulna,
The wrist consists of two rows of eight bones called carpals.
The upper ends are attached to the lower part of the radius, while their lower ends are attached to the bones of the hand (palm) which consists of long thin bones called metacarpals followed by five digits each is made of three phalanges except the thumb, which consists of two phalanges only.



(Fig. 5) The fore limb

The pelvic girdle consists of two identical halves fused at the ventral side at the pubic sumphysis.
Each half consists of ilium , ischium , and pubis.



Bones of the pelvic girdle

The hind limbs

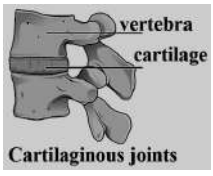
Each hind (lower) limb consists of thigh, shank, the ankle, and the foot.
a) Thigh bone is supported by femur.
b) Shank, supported by 2 bones, inner tibia and outer fibula.
The end of femur, articulate with the shank at the knee joint.
Patella is a circular bone in front of the knee joint.
The ankle consists of seven tarsals; the the heel is the largest one.
The foot has five metatarsals, which are long and thin and end with 5 toes each has 3 phalanges except the big toe which has 2 phalanges.

Secondaly: Cartilages

They are a type of connective tissues, made of cartilaginous cells and located usually at the tips of the bones especially at the joints and between the vertebra of the vertebral column to protect the bones against the corrosion due to its continues friction.

Thirdly: Joints:

1- Fibrous joints: Most of them are immovable joints, as that connect the bones of skull together through its serrated tips.
2- Cartilaginous joints: They allow a very limited movement like the cartilages between the vertebra of the vertebral column.

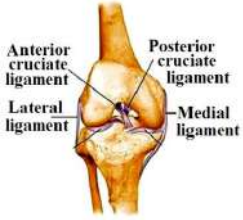


Cartilaginous joints

3- Synovial joints: represents most of body joints,
From the examples of synovial joints:
- Elbow joint and Knee joint which considered as a limited movement joints because it allow the movement of one bone in one direction only.
- Shoulder joint and Hip joint , They are wide movement joints which allow the movement of bones in many directions.

Fourthly: Ligaments:

They are separated bundles of fibrous connective tissue, its tips are fixed on the two bones of the joint, and work to link the bones with each other at the joints and determine its movement .



Ligaments in knee joint

Fifthly: Tendons:

They are a strong connective tissue that link the muscles with bones at the joints which allow the movement of muscles during their contraction and relaxation.

For example, Achilles tendon

Movement in living organisms

Types of movements

1-Continuous movement: as the cytoplasm inside any living cell.

2- Local movement (positional) As the peristalsis in the alimentary cannel.

3- The movement from place to anther: as animals move searching for food or protection

I- Movement in the plants

a) Touch movement as the mimosa plant collapse & lay down its leaves if it is touched.

b) Sleep movement in mimosa & Bean , close during darkness & open during light time.

c) Haptotropism (pulling movement).

- Pulling movement in pea :

In pea the tendril twins round the support due to the accumulation of auxins at the side away from the support ,it grows faster than the side near to the support, so the tendrils twins.

If the tendril does not find the support, it dies

- Pulling movement in bulls by pulling roots, to support the aerial parts.

d) Cytoplasmic streaming

The cytoplasm of the living cell rotates continuously for transportation inside the cell

Second: Movement in man

Movement in the human beings depends on the presence of 3 systems:

1- Skeletal system for support. 2- Muscular system for movement.

3- Nervous system gives the order to control the muscles movement.

The Muscular system

The unit structure of the muscular system is the muscle.

The muscle consists of a muscular tissue have the ability to contract and relax causing motion, the muscle usually known as flesh.

Functions of muscles:

1) Movement. 2) Transportation 3) Movement of the blood 4) Maintain body position

Structure of the muscle

The muscle consists of a large number of units called muscle cells or muscle fibres.

Each group of muscle fibres are collected to form muscle bundle which surrounded by a membrane called **perimycium**.

It consists of a living cytoplasm called sarcoplasm surrounded by cell membrane called sarcolemma.

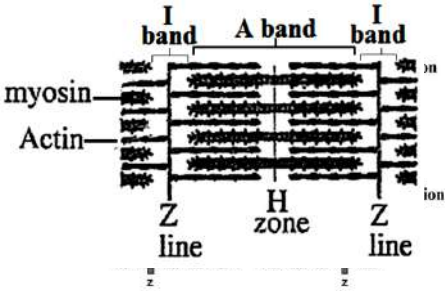
Each muscle fibre (cell) consists of from 1000 to 2000 **myofibrils**(very small fibres)

Myofibrils arranged longitudinally and parallel to the longitudinal axis of the muscle.

Each muscle fibre (cell) contains a large number of nuclei (multinucleated).

Structure of muscle fibre under the electronic microscope (muscle cell)

Muscle contraction



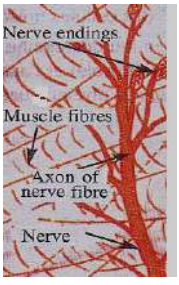
Muscle contraction

1. In skeletal muscles, the outer surface of the muscle fibre membrane is (+ve) while the inner surface is (-ve), that form potential difference due to the unequal distribution of the ions outside & inside the membrane.
2. The stimulus for muscle contraction is the motor impulses that coming from the brain and spinal cord through the motor nerve
3. When the motor impulses reach the synapse, the calcium pump help the vesicles to release the acetylcholine through the synaptic cleft between the nerve fibre and the muscle fibre.
4. So, the permeability of the muscle fiber change and, Na+ pass through the membrane causing depolarization (+ve inside and -ve outside) causing muscle contraction
5. After a part of a second "repolarization" takes place because of Cholinesterase enzyme, destroys acetylcholine to return the permeability of the membrane to ions to the resting state to be ready to new stimulus and respond again and so on.

Mechanism of muscle contraction The sliding theory (Huxely theory)

Huxely compare between the muscle fibre in a states of contraction and relaxation using electron microscope.
Huxely concluded that, the protein filaments slide over each other due to the presence of transverse links extended from the myosin filaments & attach to the actin filaments.
In presence of calcium ions and energy (ATP), the transverse links act as hooks that pull the actin filaments from both sides towards each other leading to muscle contraction.
Huxely theory does not explain the contraction of unstriated smooth muscle although scientific reports suggest that the protein filaments in smooth muscle are almost similar to that in skeletal muscles.

The Motor Unit



The motor unit is the unit of function of the skeletal muscles.
The muscle contraction is the sum of all motor units forming the muscle.
When the nerve fibre enters the muscle, it divides into a large number of branches, which supply a group of muscle fibres (from 5 to 100).
The neuromuscular junction:
It is the point of connection between terminal branch of the motor nerve fibre and the motor end plate of the muscle fibre.

Muscle fatigue

The muscle fatigue is due to the shortage of oxygen needed for respiration
Accordingly the muscle converts glycogen to glucose which oxidized anaerobically to produce (2ATP) to allow the muscle to contract, causing the accumulation of lactic acid.
The shortage of ATP in the muscle leads to prevent the separation of the transverse links from the actin filaments, so the muscle still in the case of contraction and can't relax that causing painful muscle spasm.

Chapter (2)

Hormonal co-ordination in living organisms

The Endocrine System

The endocrine glands are ductless glands secret hormones in the blood directly.

Discovery of the animal hormones:

1- Cloud Bernard considered that stored sugar in the liver is an internal secretion while bile is an external secretion of the liver.

2- Starling He cut the nerve connection between the pancreas & all the other body organs; he noticed that the pancreas secreted its juices when the food reaches the duodenum due to secretion of hormones from the duodenum mucous membrane .

The importance of Hormones in plants (auxins)

1- Regulate plant growth 2- Regulate the tissues development

3- Controle the leaf fall, the formation of flowers and fruit. 4- Affect the tissues functions

5- Allow the man to control the plant growth according to his wills.

Hormonal regulation in man

Characteristics of Hormones:

1. They are organic substances as, proteins, amino acids, or steroids (lipid derivatives).
2. They secreted in very small amounts (1/1000 milligram).
3. They carry out important functions as:

a) Keep the internal environmental balance of the body (homeostasis).

b) Regulate the body growth. c) Regulate the sexual maturity.

d) Regulate the metabolic activities. e) Regulate the behavior & the mental development

Types of the human glands

1. Exocrine glands: They have ducts to carry the secretions inside the body.

2. Endocrine glands: (Ductless glands) secret hormones directly to blood.

3. Mixed glands: Each consists exocrine and endocrine parts, such as pancreas.

First The pituitary gland (Below the brain)

The gland consists of two parts Adenohypophysis & Neurohypophysis

A Adenohypophysis: consists of the anterior and middle lobe .

1. Growth hormone (G.H.)

It controls metabolism especially protein synthesis & the body physical growth.

☻ **Hypersecretion** (Excessive secretion) ⇄ During childhood causes Gigantism. During adults causes Acromegaly.

☺ Hyposecretion (deficiency) of (G.H) during childhood causes Dwarfism

2. Pituitary Trophins A group of hormones that affect the secretion of other glands as

a) Thyrotrophin (thyroid stimulating hormones) (T.S.H.).

b) Adrenocorticotrophic hormone (A.C.T.H.) (affects the function of adrenal cortex.

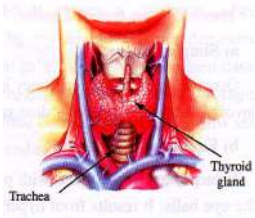
c) Gonadotrophic hormones as (F.S.H), (L.H) and Prolactin

Prolactin: It stimulates the secretion of milk from mammary glands (breasts)

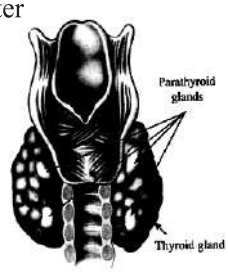
B) Neurohypophysis**:**

The nerve cells in the **hypothalamus** secrete (A.D.H) and Oxytocin.

Second: Thyroid gland (Activity gland)



It is formed of two red lobes connected together by an isthmus
The gland secrets two hormones ***thyroxin*** and ***calcitonin***
The Functions of thyroxin hormone
It stimulates physical and mental growth and development.
It affects the basal metabolic rate.
It increases the absorption of carbohydrates from the intestine.
It protects the healthy of the skin and the hair.
The Functions of calcitonin hormones
It decreases the calcium level in the blood & prevents its absorption from the bones.
Hyposecretion (deficiency) of thyroxin H. (Hypothyroidism)
Hypothyroidism occurs due to iodine deficiency in food, causes ***Simple goiter***.
Hypothyroidism leads to cretinism in children.
Hypothyroidism leads to Myxodema in adults.
The treatment of *Myxodema* is by using thyroxin hormone or the gland extracts with regular consultation of a specialist.
Hypersecretion of thyroxin H. (hyperthyroidism) causes Exophthalmic goiter
Treatment Exophthalmic goiter
a) Removal of the enlarged part of the gland surgically.
b) Using the medications to suppress the gland.



Third: Parathyroid glands Bone glands

It consists of 4 small lobes, at the 2 sides of the thyroid gland.
They secret ***parathormone*** hormone
The Function of parathormone
Parathormone H. increases the calcium level in the blood (antagonize Calcitonin)
The hypersecretion of parathormone (Hyperparathyroidism) leads to
Increase in the calcium level in blood causing bones fragile because the large amount of Ca^{++} extracted from the bones, & lead to its fracture.
The Hyposecretion of parathormone (Hypoparathyroidism) leads to:
1- Decrease in the calcium level in blood.
2- Increase excitability of nervous system.
3- Painful and muscle spasms.

Fourth : Adrenal glands (Suprarenal gland)

The adrenal glands are two glands above the two kidneys.

The Cortex Hormones

(Glucocorticoids , Mineralocorticoids & Sex hormones)
1) Glucocorticoids: Include *cortisone H.* and *corticosterone H.*
2) Mineralocorticoids: *aldosterone H.*
- It increases the reabsorption of sodium and increases the excretion of potassium from the kidney tubules.

3) Sex hormones:
The adrenal cortex secretes male sex hormone and secretes female sex hormones .
Tumors or unbalance secretion of adrenal cortex leads to musculanization in female, feminization in male and atrophy of gonads in both sexes.

The medulla Hormones

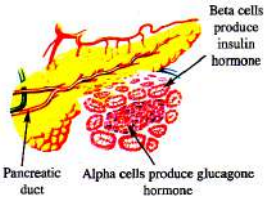
The function of the medulla hormones (***Adrenaline*** H. and ***Noradrenaline*** H.) (During emergency situations &muscular exercise)

1- They increase the sugar (glucose) level in the blood by change glycogen into glucose

2- They increase the rate of heart beating and increases blood pressure.

3- They increase the rate of oxygen consumption to release energy.

Fifth: The Pancreas (sugar gland)



It is a mixed gland with exocrine secrets pancreatic juice into duodenum and endocrine (secrete insulin & glucagon hormones)

Islets of Langerhans,

a) Alpha cells are small in number and secret glucagon hormone.

b) Beta cells are the majority of cells and secret insulin hormone.

The two hormones keep the glucose level in the blood at 80-120 mg/100 cm^3 blood.

Decrease the insulin secretion leads to a disease called ***Diabetes Mellitus***

The symptoms of Diabetes Mellitus (Mellitus = sweet)

Disturbance in the metabolism of carbohydrates and lipids.

Increase glucose level in the blood 3- Excretion of glucose in urine .

4- The excessive micturition (urination) 5- The continuous thirst sensation.

Functions of Glucagon:

It antagonizes the action of insulin, where it increases the glucose level in the blood through the conversion of glycogen to glucose (only in liver).

Sixth: Sex glands (The gonads)

1. Male sex hormones

Androgens secreted from the interstitial cells of testes.

The functions of Testosterone and androsterone

- The growth of the prostate gland, seminal vesicles and the appearance of male secondary sexual characters.

2. Female sex hormones (They are Oestrogen, Progesteron & Relaxin)

Oestrogen (oestradiol):

It is secreted from the graafian follicle of ovary or from the placenta during pregnancy.

The function of Oestrogen

-It helps the appearance of secondary sexual characters. and regulates the menstrual cycle.

Progesteron:

It is secreted from the corpus luteum of the ovary and the placenta during pregnancy.

The functions of Progesteron

During pregnancy: it regulates the vascularity of the uterine wall .

It is responsible for the changes taking place in mammary glands during pregnancy

Relaxin: It is secreted from the corpus luteum, placenta, and uterus.

causes relaxation of the muscles of the pelvis at the end of pregnancy to facilitate delivery.

Seventh: Gastrointestinal Hormones

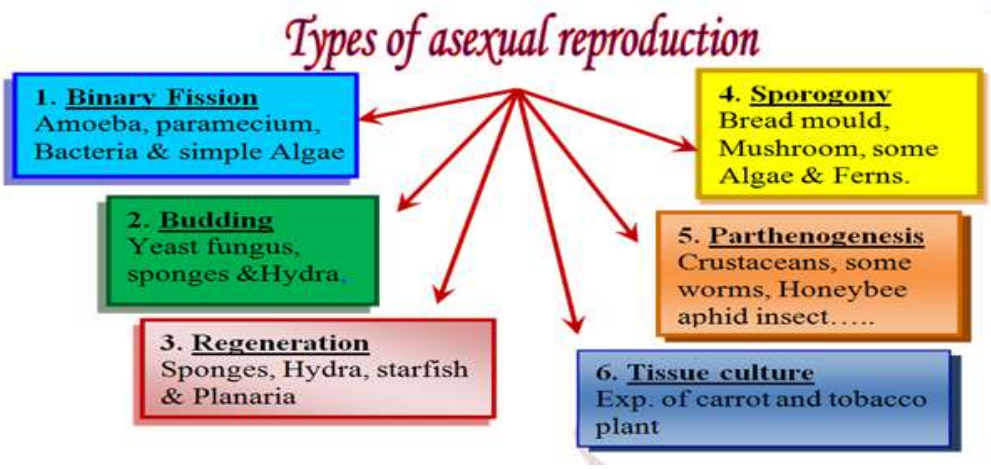
- Gastrin is secreted from the stomach wall.
- Secretin and cholecystokinin which are secreted from the intestinal wall.

Chapter (3) **Reproduction in living organisms**

The conditions of reproductive capacities among organisms
1. The surrounding environment (ambient):
2. Dangers to which the organism is exposed:
3. Nature & duration of the organism's life:

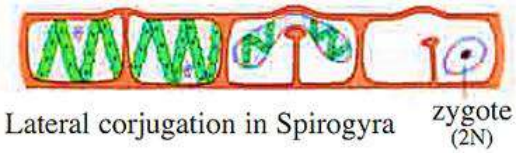
Methods of reproduction in living organisms

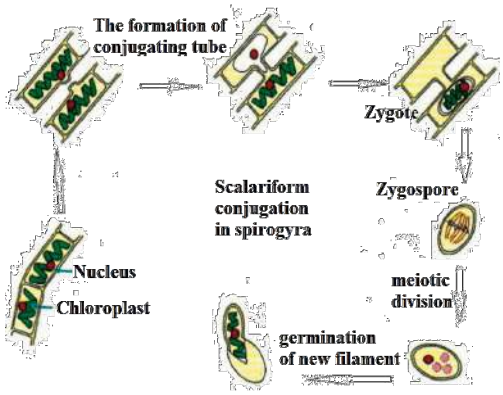
1- Asexual Reproduction. 2- Sexual Reproduction. 3- Alternation of generations.



Second. Sexual Reproduction:

Types of Sexual Reproduction 1.By Conjugation. 2- By sexual gametes.
1) Conjugation in Spirogyra
It takes place at unsuitable conditions.
The reproduction occurs also asexually at suitable conditions,
In primitive organisms such as some Protozoa, Algae and Fungi,
Types of conjugation a) Scalariform conjugation b) Lateral conjugation
The cells of spirogyra filament are haploid (N), but, the zygote (2N
In zygospore the nucleus divides by meiosis before germination to form haploid cells of the new filament.





Third: Alternation of generations

The life cycle of the living organisms includes two generations, one as the result of sexual reproduction while the other as the result of asexual reproduction as some plants and animals species.
They gain from both methods their advantages of rapid production and genetic variation. These enable them to spread widely and to adapted with the change in the environmental conditions. **Examples** (Plasmodium - ferns as Polypodium & Adiantum)

1. Life cycle of Plasmodium (Malaria parasite)

It is transmiteted by female Anopheles mosquito.
the infected mosquito bites human skin & pours Sporozoites in his blood
Sporozoites spend an incubation period in the liver where they divide by Schizogony giving several Merozoites by 2 cycles of asexual reproduction.
Merozoites infect red cells and produce huge numbers of Merozoites that are released together every 2 days causing the symptoms of Malaria fever as heat, chill and sweating.
Some Merozoites change into inactive gametocytes in the human blood
When the another mosquito bites the patient skin, gametocytes migrate to the mosquito with patient's blood where they activated and develop to gametes in mosquito's stomach.
Gametes fuse into a zygote (2N) that changes into Ookinete(2N), which penetrates into stomach wall &divided by meiosis (meiotically) producing, Oocyst(1N).
The nucleus of Oocyst is divided to form Sporozoites which move towards the mosquito's salivary glands to be ready for human infection.

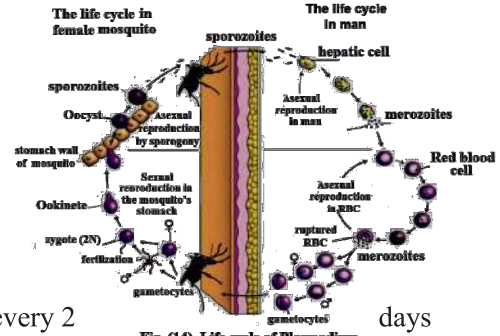
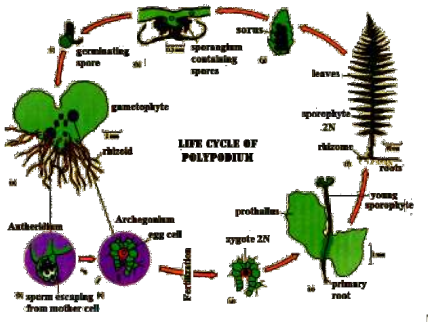


Fig. (14) Life cycle of Plasmodium (Malaria parasite)

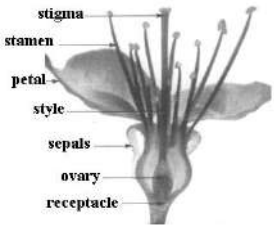
2. Life cycle of Polypodium

the lower surfaces of the sporophyte leaves have the sori, which contain spore mother cells (2N), which divide by meiosis giving the spores (N).
The spore germinates in wet soil to form a heart-shaped "gametophyte"
The gametophyte produces rhizoid to absorb water & salts from the soil.
The gametophyte carries male organs (Antheridia) & female organs (Archegonia)
The male gametes fertilize the eggs forming the zygote (2N).
The zygote divides to form sporophyte that grows over the gametophyte and depends on it until developing its own roots, stem and leaves.



Reproduction in Flowering plants

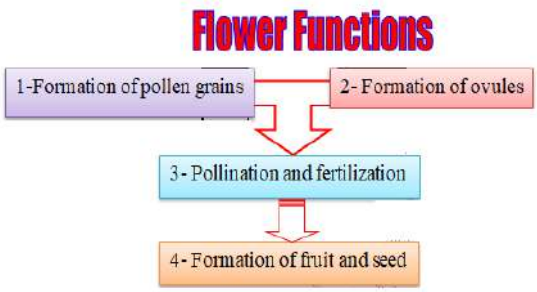
Angiospermae are flowering plants their seeds develop with a pericarp.
The flower is a short stem its leaves are modified into floral parts.
The flower arises from the axial of either a green or a scale leaf called bract, in some cases flowers occur without bracts.
The inflorescence is a group of flowers on the floral axis in different aggregations as in beans and manthur.
The Stalked flower is a flower which is carried on a pedicle.
The Sessile flower has no pedicle.

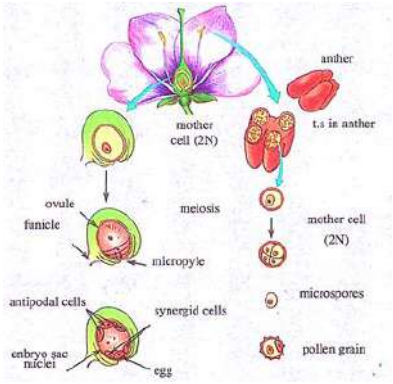


The typical or complete flower
1) Calyx: It is the outer whorl of the flower, green leaves known as sepals **ts functions**: protect the inner parts of the flower against drought, rain or wind.
2) Corolla: It is composed of coloured leaves called petals,
its functions It protect the floral sexual parts to attract insects for pollination.

In flowers of most monocot plants as Tulip and Onion, leaves of the calyx& corolla are similar in structure and colour , so they are called **perianth.**

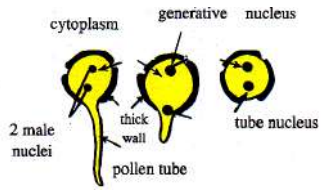
3) Androecium: It is the male organ, that consists of stamens. Each stamen consists of a filament which carries anther that contains pollen grains.
4) The Gynoecium: female organ and is the central whorl consists of carpels,
Each carpel consists of ovary contains the ovules, style & stigma





3- Pollination and fertelization

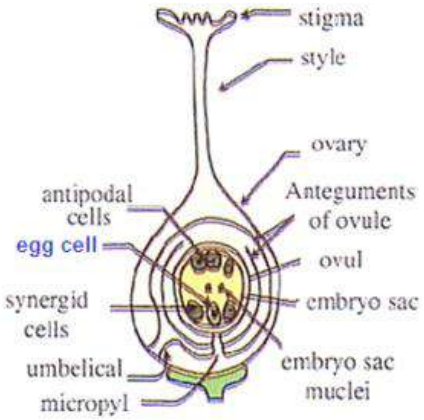
It is the transferring of pollen grains from the anther to the stigma of the flower.
Types of the pollination: 1. Self pollination 2. Cross pollination
The factors that need cross-pollination
1- Flowers are unisexual.
2- Organs of one sex mature before the other.
3- Height of anthers is lower than the stigma
Methods of cross-pollination:
It takes place by air, insects, water and man.
The stages of Fertilization:
1. Pollen grains germination:



The pollen grain germinates on the stigma, by the formation of pollen tube reaches the micropyle of the ovule
The generative nucleus is divided by mitotically into ***2 male nuclei*** each (N), ***One of them*** fuses with the egg nucleus (N) forming the zygote (2N), which forms the embryo (2N) while ***the othe***r fuses with the two embryo sac nuclei (2N) to form the endosperm nucleus (3N) (**triple fusion**)

Double fertilization

It is the fertilization of egg nucleus (N) by male generative nucleus to form the zygote & the fusion of male nucleus (N) with the two embryo sac nuclei (2N) to form the endosperm nucleus(3N) at the same time.



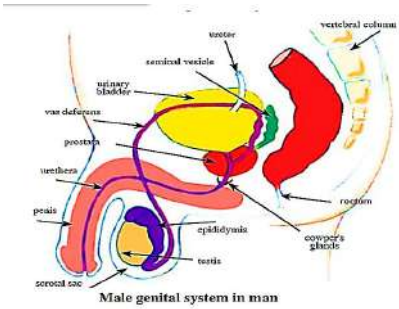
Section of mature ovary

2. The Formation of fruit and seed: (ovule develops into the seed)
According the presence of the endosperm tissue the seeds divided into two groups Endospermic seeds which contain endosperm and Exendospermic seeds which doesn't contain endosperm
The integuments of the ovule harden forming the seed testa.
- After fertilization, the calyx, the corolla, the Androecium, the style and stigma wither and fall out while the ovary change into fruit ,The ovary's wall change into the pericarp, and the ovule wall into the coat(testa).
The 2 synergid cells and antipodal cells disappear
The micropyle has two functions 1- allaw the passage of pollen tube for fertilization 2- to allow water to get into the seed during germination.
There are some fruits which keep some parts of the flower - for example:
1. Leaflets of the calyx and the stamens remain with pomegranate.
2. The calyx may take part in eggplant and dates fruits.
3. The corolla leaflets may stay on marrow fruits.

False fruit: It is the fruit in which the receptacle or any part share ovary to store food as in apple where the receptacle may share in fruit formation.
Pollination also stimulates the auxins necessary for developing the ovary into a mature fruit.

Reproduction in Human Beings

The structure of male reproductive system
It consists of two testes, each leads a group of tubules called epididymis which connected to the vasdeferens that lead to urethera,
The accessory glands(two seminal vesicles,Prostate gland& Cowper's glands.



Male genital system in man

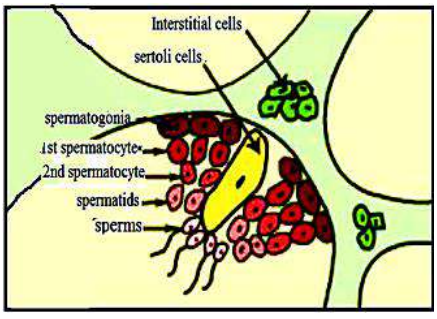
a) The two testes:
The testis lies outside the body in the scrotal sac to provide condition cooler than the body temperature to be suitable for spermatogenesis.
The importance of the testis (reproductive system):
1. The production of sperms.
2. The secretion of testosterone hormone, which causes the appearance of male secondary sexual character.

b) The two epididymis:
In which the sperms are stored until they leave the body.

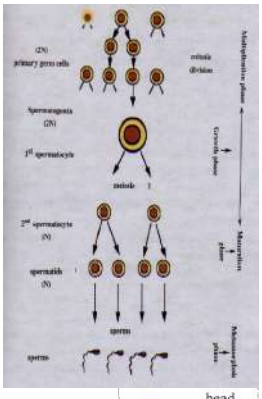
c) The two-vas deferenses:
Each transports sperms from the epididymis to the seminal vesicle.

d) The two seminal vesicles:
They secret food substance contain fructose to feed the sperms

e) Prostate gland and Cowper's glands:
1- They secrete a sugary fluid (which feed sperms)
2- They secrete an alkaline fluid to neutralize the acidity of the urethra just before the sperms, because the neutral medium suits of the sperms.

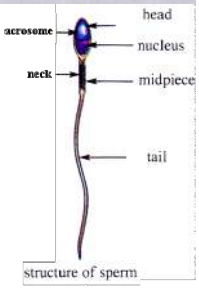


f) The penis:
It is an organ consists of a spongy tissue, through which the urethra passes.
Male secondary sexual characters
1-The voice becomes deep 2- Muscles grow stronger
3- Growth of facial hair.
Study of a T.S. of testis:
The testis is built up of seminiferous tubules among them these are ***interstitial cells*** which secrete the testosterone hormone.
The ***sertoli cells*** which secrete fluid to feed the sperms inside the testis.
It is supposed that, they gave also immunization function.
Each tubule is lined internally with primary germ cells (diploid) (2N) they are divided to form sperms.



Phases of spermatogenesis

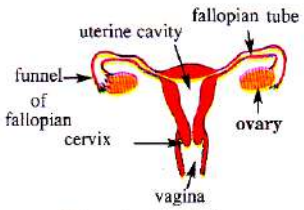
1) Multiplication phase:
The primary germ cells(2N) are divided by mitosis several times to produce a great number of spermatogonia cells (2N) .
2) Growth phase:
The spermatogonia cells store food to change into primary spermatocytes.
3) Maturation phase:
The primary spermatocytes (2N) are divided by meiosis (1) to produce secondary spermatocytes (N) which are divided by meiosis (2) to produce spermatids (1N)
d) **<u>Metamorphosis phase</u>**: The spermatids are converted into sperms.



Structure of sperm

It consists of head, neck, midpiece & tail
a**) The head** contains nucleus {(1N) = 23 chromosomes} & acrosome
The function of acrosome secretes the hyaluronic enzyme that dissolves a part of the ovum membrane, to facilitate its penetration process.
b) **The neck** contains two centrioles, for the division of the fertilized ovum.
c) **The midpiece** contains mitochondria to produce energy for movement.
d) **The tail** consists of an axis, which ends with caudal piece to help the sperm to move.

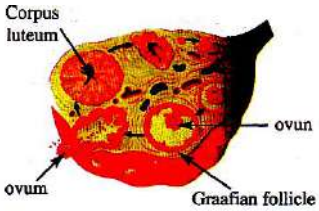
The human female genital system



Female genital system

Its Function .
The production of mature ova
The secretion of famale sex hormones.
Providing a safe place for fertilization.
Providing a safe place for embryo dvelopment till birth .
The number of mature ova
During childhood, each ovary contains several thousands of ova in different development stages but about 400 only will mature
They consumed during 30 years (active reproductive life =***fecundity years***)
The ovaries are alternated the production of one mature ovum each month.
It secretes the maturation hormones for regulating menstrual cycle and embryo development.
The organs of this system lie behind the urinary bladder and connected the with the pelvic region by elastic ligaments.
The pelvic region is expansion during pregnancy.
Its structure
It consists of two ovaries, two oviducts, the uterus and the vagina
The two ovaries:
Each has an oval shape equals in size a peeled almond &lie on the sides of the pelvic cavity.
b) The two fallopian tubes (oviducts):
Each has a funnel shaped opening facing one of the to ovaries with finger like protrusions and cilia to direct the received ovum toward the uterus.
c) Uterus:
It is sac-like elastic organ lies in the pelvic cavity lined with a glandular membrane andended with the cervix which opens to the vagina.
d) Vagina:
It is 7cm muscular tube connect between the carvix and the genital opening ,It has folds to allow its expansion during birth.
The female sexual maturity At the age from 12 : 15 year.
Menopause: At the age of 45- 50 year, when the ovaries become inactive, which decreasing the secretion of hormones and the uterine lining is wrinkled.

Study of T.S. in the ovary..
The ovary consists of a group of cells in different stages and ovum inside Graafian follicle.
When the Graafian follicle releases the mature ovum, it transformed into the corpus luteum.

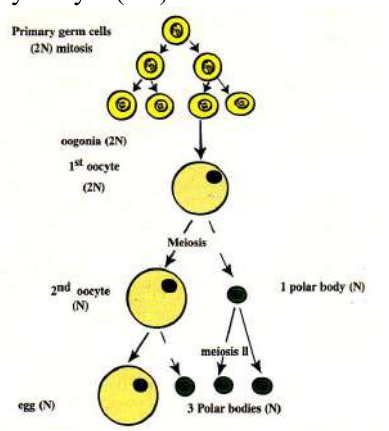


The three Stages of oogenesis:

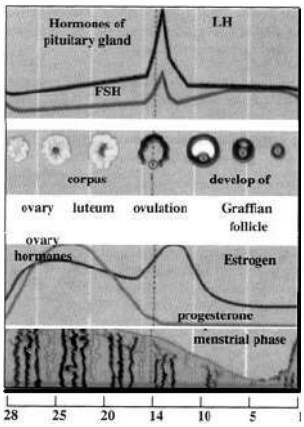
a) Multiplication phase: (In the embryo stages)
The primary germ cells (2N)divided mitotically into a number of oogonia(2N)

b) The growth phase: (In the embryo stages)
The oogonia (2N) store food, increase in size & become primary oocyte (2N)

c) Maturation phase:
The primary oocyte (2N) is divided first miotic division into secondary oocyte and 1st polar body (N)
Then the secondary oocyte is divided second miotic division giving an ovum and 2nd polar body.
The polar body is divided by miotic division producing two polar bodies.
The resultant is an ovum and three Polar bodies.
The ovum is covered with a thin cellular coat
its cells are held together by hyaluronic acid,
The acrosomes of sperms secrete enzymes
to dissolve this coat so, millions of sperms are required to penetrate the ovum.



Breeding cycle is the periods in the life of placental mammals, where the ovary becomes regularly active in the adult female.
The period cycles differs in various mammals. Lion and tiger is annual ,Cats and dogs twice a year ,but in r rabbits and rats frequently per month



The three phases of menstrual cycle

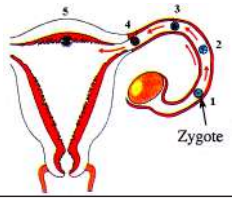
1- Phase of proliferation (10 days):
The pituitary gland secretes (FSH) to stimulate the ovary to produce Graafian follicle which contain the mature ovum and secretes estrogen which stimulates the growth of the endometrium.

2- Phase of ovulation(14 days):
The pituitary gland secretes (L.H.) to stimulate the Graafian follicle to liberate the ovum and changes into corpus luteum.
The corpus luteum produces progesterone and estrogen hormones to increase the thickness of the endometrium, and its blood supply.

3- Phase of menstruation (3-5 days):
If the ovum is not fertilized the corpus luteum degenerates gradually.
Therefore, the secretion of progesterone stops , so the endometrium degenerates and the blood vessels tear due to the successive contractions of the uterus, Thus menstrual bleeding takes place. This lasts 3-5 days' and a new cycle of the other ovary begins.

Fertilization:
It is the fusion of the male gamete (sperm) with the female gamete (ovum) to form the zygote, which divides forming the embryo.

Pregnancy and embryonic development
After one day, the zygote divided mitotically into 2 cells (two blastomeres) in the upper part of fallopian tube, & four cells in the next day and morula after 1 week reach the endometrium.
The rate of cellular division increases to form a small mass called morula.



Splitting of the zygote

Embryonic membranes:
The outer embryonic membrane is the chorion, & the inner is the amnion.which surrounds the embryo with a fluid to protect it against shocks and dryness.

The umbilical cord
The embryo is connected with the placenta by the umbilical cord, its length is about 70 cm its length increases to give more freedom for the motility of the embryo.

The importance of placenta:
- It transfers digested food, water, oxygen and vitamins from mother's blood to the embryo.
- It secretes the progesterone hormone at the beginning of 4th month of pregnancy .
- It also transfers the drugs, harmful and virures from mother to the embryo .

The three stages of embryonic development
1) **The first stage**: (the first three months of pregnancy)
* The nervous system and the heart start their development, the hands and eyes become differentiated, also the two sexes become differentiated and response to stimuli becomes established.
* In the **1st** month, nervous system &heart start to develop.
* In the 6th week, the testes are developed.
* In the 12th week, the ovaries are developed.

2) The second stage: (the middle three months)
* The development of the heart is completed & its beats can be heard.
* Ossification and support of the skeletal system takes place.
* The sense organs are completed and size growth increases.

3) The last stage: (the last three months)
* The development of the brain is completed. * The growth slows down
* The development of the other internal system is completed.
* ***In the ninth month***, the placenta dissociates gradually, So, progesterone decrease and attachment between the foetus and uterus becomes loosened preparing for birth.
* Labor begins with the contraction in the uterine wall until the foetus is expelled outside.

The importance of mother's milk for the baby:
It supplies the baby with the most valuable nutritive and emotional supply, protecting him from many somatic and psychic diseases in his future .

Means of contraceptive:

1. The pills contain synthetic estrogen and synthetic progesterone hormones.

2. The intrauterine device (the coil): It is inserted into the uterus cavity to prevents the fertilized ovum to be implanted in the uterus.

3. Condom: It prevents the sperms from entering the vagina.

4. Surgical sterilization:

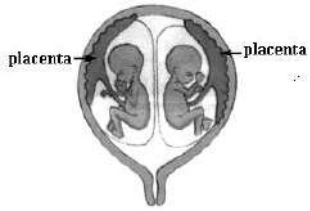
In woman by cut or tide the two fallopian tubes, or by cut or tide the van deferens in man,

Multiple birth

The international percentage of twins is once in about 86 births.

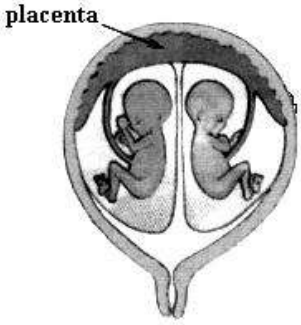
Identical (Monozygotic) twins

- It results from one ovum by one sperm, They are identical genetically and have one placenta .These twins may be born partially attached to each other in some place in the body. (Siamese twins).



Fraternal (dizygotic) twins

- It results from two ova with two sperms ، Each zygote developed into embryo .So, they differ genetically



Test tube babies

A mature ovum is obtained from wife's ovary and being fertilized externally with the husband's semen inside test tube in a certain nutritive medium till reaches to the morula. Then it is reimplanted in the wife's uterus to complete its embryonic development till birth.

Renucleation :

Experiments has been conducted on frogs and mice.

Gamete banks:

These banks are store selected animal gametes especially those of cattle and horses to keep them available for reproduction till the time of need.

The gametes are stored in a frozen liquid nitrogen condition (-120 °C) for up to 20 years, It is possible to separate the sperms with (X) chromosome from sperms with (Y) chromosome by laboratory means such as centrifugation or exposure to a limited electric field.

Immunity in living organisms

Chapter 4:

The sources of threats

Biological sources as pathogens including some insects, , protozoa, fungi, bacteria& viruses

Non-biological sources such as accidents, natural disasters, disturbance in the environment.

The defense mechanisms against the threats:

1- The camouflage (change of color).
2- The secretion of toxins to kill other organisms.
3- Running to escape.

The immunity is the body's ability through the immune system to resist the pathogens, through preventing the entry of pathogens into the body of the organism or by attacking the pathogen and foreign bodies and destroy them when entering the body of the organism.

Immunity in Plant

The three main reasons that cause disease and death to plants :-

1. The dangerous enemies: ,2. The unsuitable conditions: 3. The toxic substances:

First: The Structural immunity:

It is the first line of defence to prevent pathogens from entering and spreading inside the plant, It is a natural barriers which include two types:

A- Pre-existing structural defences as

1-The epidermal cells of the plant.

The epidermis act as the first bulwark in the resistance, and may be covered with waxy layer.

2- The cell wall:

The cell wall represents the outer protection of the cells, especially the epidermal layer, which consists mainly of cellulose and after thickening by lignin that makes it so difficult for the pathogens to penetrate.

B- Induced structural defences

It is represented by the following:

1-The cork formation 2-The Formation of tyloses

3-The Deposition of gums.

4-Cellular immune structures as a-Swelling the cell walls b-Surrounding the mycelium .

5- Getting rid of the injured tissue (Hypersensitive Response)

Second: The Biochemical immunity (Biochemical defenses)

The Immunological mechanisms include the following:

1- The Receptors that recognize the presence of the pathogen and activate the plant defenses. These **compounds** are found in healthy and infected plants, but the concentration increases in the plants after the infection.

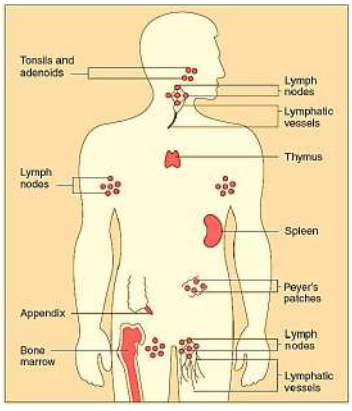
2-Antimicrobial chemicals: as Phenols and Glycosides. Production of non-protein amino acids as Canavanine and Cephalosporin

3-Antimicrobial proteins(as detoxifying enzymes)

4-Inducible post-infection

Some plants promote and strengthen their defenses after the infection in order to protect them self from any new infection.

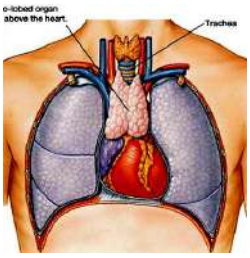
Immunity in human



Human immune system

They are scattered, and not linked to each other in anatomical succession, but the organs of the immune system functionally act as one unit and called the lymphoid organ.
Firstly: The Lymphoid organs
These organs contain large numbers of lymphocytes where maturation and differentiation of lymphocytes take place**, Examples of the lymphoid organs**

a- Bone marrow



The site: It is a tissue inside the bones
The function: They produce red blood cells, white blood cells, and blood platelets.

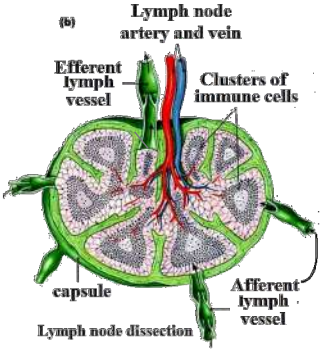
b- Thymus gland:
The site: on the trachea **above** the heart and **behind** the sternum bone.
The function: It secretes ***Thymosin hormone*** which stimulates the maturity of lymphoid stem cells to be T- cells and their differentiation into different types inside the Thymus gland.

c-The spleen:

- It is a dark red small organ, its shape is not more than the fist.
The function: It plays an important role in the body's immunity, since it has a lot of ***macrophages*** which pick up all the strange bodies, also it contains ***lymphocytes***, which release a special proteins as anti-bodies .

d- Tonsils:
The site: two specialized lymphoid glands on both sides of the rear portion of the mouth for picking up any microbe

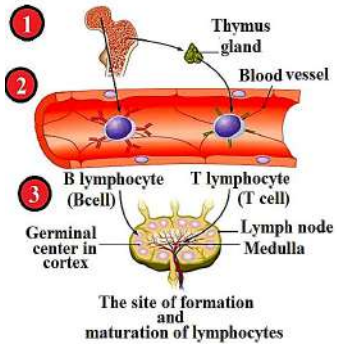
e- Peyer's patches



They sre small lymphoid cells that accumulate in the form of masses or aggregations spread to the mucous membrane lining the lower part of the small intestine ,they play a role in the immune response against pathogenic microorganisms that enter the intestine.

f- The lymph nodes
The lymph nodes present along network of the lymphatic vessels that located in all the body parts under the armpits, at the two sides of the neck ,in upper thigh, and near the internal body's organs.
The function: They purify the lymph from any harmful substances or microbes and store white blood cells .
Their size ranging from a pinhead, to the seed of small beans.
The node is divided internally into pockets filled with B- lymphocytes, T- lymphocytes, and macrophages that get rid germs and the debris cells.

Secondly: The Lymphocytes



They form about **20% : 30%** of the white blood cells .
All Lymphocytes are formed in the bone marrow,
They revolve in the blood to research for any microbe or foreign body, and allow their defense and immune mechanisms to get rid of the pathogenic microbes that invade the body, and reproduce to spread inside the body.
There are three types of lymphocytes in the blood which are:

a) B- cells

they formed in the bone marrow and complete their growth to become mature.
They identify any microbes or foreign materials (such as bacteria or virus),then adhere this foreign material and produces antibodies to destroyed it.

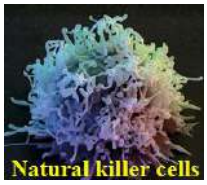
b) T- cells

They form about 80% of lymphocytes, which mature in the thymus gland and differentiate into several types:

1) Helper T cells (T_H) activate other types of T cells and stimulate it to do their responses, as well as stimulate B cells to produce antibodies

2) Cytotoxic T-cells: (or killer T cell) (T_C) attack the foreign cells where, It kills carcinogenic cells , the transplanted organs and the body cells that infected with a virus.

3)Suppressor T-cells (Ts): They regulate the degree of immune response required to limit and discourage or inhibit the action of T cells and B cells after removing the pathogen.

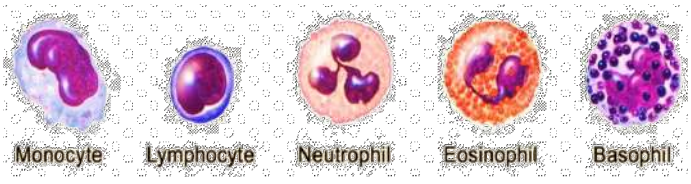


c) Natural killer cells:

The site: They form about 5% to 10% of lymphocytes in blood, and they are produced and mature in the bone marrow.
The function: They kill tumour cells, virus-infected cells, and transplanted cells

Thirdly: The other white blood cells:

They are the basal cell **(Basophils)**, acidic cells **(Eosinophils)** and neutral cells (Neutrophils).
They are distinguishable from their size and the color of the granules appeared inside by using the microscope..
They still in the blood circulation for a short period (from several hours to several days.)
This, in addition to a single-core Monocytes cells that destroy foreign bodies, and change into phagocyte cells when needed, and engulf the foreign organisms.



Fourthly:Macrophages Including two types:
1- The fixed macrophages:
2- Mobile macrophages:

Fifthly: Assisting chemical substances:
These chemicals help and cooperate the specialized mechanisms of the immune system; they are many chemicals such as:

a - Chemokines:
They attract the phagocyte cells with large number to the sites of microbes .

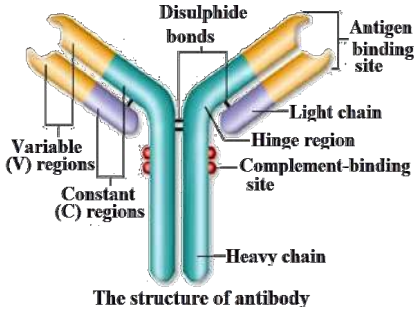
b - Interleukins:
They mediate communication between different cells to perform its defense function.

c- Complements:
They are different types of proteins and enzymes that destroy microbes in blood after their conjugation with antibodies, they lyses the membranes of antigens and dissolve their content, which makes them easily engulfed by phagocytes.

d - Interferons:
They are different types of proteins that produced and secreted by cells invaded by viruses .

Sixthly: Anti - bodies:
The surface of bacteria cells that invade body tissues have compounds called antigens.
The receptors on the surface of B- lymphocytes recognize and join with antigens on the surface of bacterial cells or foreign bodies and produce antibodies. epsilon
Antibodies are specific proteins known as **I**mmuno**g**lobulin
(**Ig**) , they are five types Ig G, Ig A, Ig M, Ig E and Ig D which circulate in the blood and the lymph.

Antibody Shape and structure
Antibodies are proteins called immunoglobulins (Igs) that are Y- shaped and are present in the blood and the other body fluids of the vertebrates as the human beings.
They are produced by antibody-secreting plasma B- cells.
The antibody consists of two **pairs** of polypeptide chains, two of these chains are long and called heavy chains; the other two chains are short and called light chains, the four chains are joined together by disulphide bonds .hinge regions
Each antibody has two identical antigen- binding sites; the shape of these sites is different from an antibody to another.
The specificity of the antibody is determined by the conformation of amino acids



The structure of antibody

The Mechanisms of Antibodies:
Antibodies have only two antigen- binding sites, whereas as antigens have many binding sites, which makes a confirmative binding between the antibodies and their antigens.
Antibodies stop the action of antigens by using one of the following mechanisms:
1-Neutralization 2- Agglutination 3- Precipitation. 4- Lysis 5-Antitoxins

The Immune system mechanism in Man

How the human body protects itself from pathogen?

There are two systems of immunity in man:

1) Natural (non-specific or innate) immunity

2) Acquired (specific or adaptive) immunity:

Firstly: Natural (non-specific or innate)

The first line of defense:

-It includes a group of physical or natural barriers in the body such as the skin, cerumen, mucus, tears, sweat, and hydrochloric acid of the stomach.

The main function of this line is preventing pathogens from entering the body.

1) The skin 2) The cerumen (ear's wax) 3) The tears

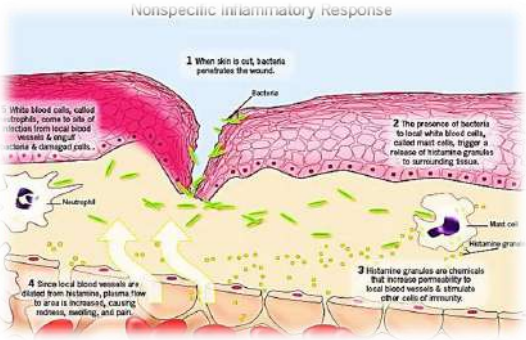
4) The mucus in the respiratory tracts: 5) The saliva:

6) The acidic gastric juice:

2) The second line of defense:

Inflammatory response:

It is a nonspecific defense mechanism in the area of injury as a response to the damage of tissues .



The blood vessels dilate to the maximum limit because of secreting the **histamines**, that secreted by specific cells like **mast cells, basophils,** these substances increase the permeability of arterioles and capillaries to allow the blood fluids to leak from the blood circulation, leading to the swelling of tissues in the site of injury, and it also allows the passage of chemicals that kill and **dissolve** bacteria to the site.

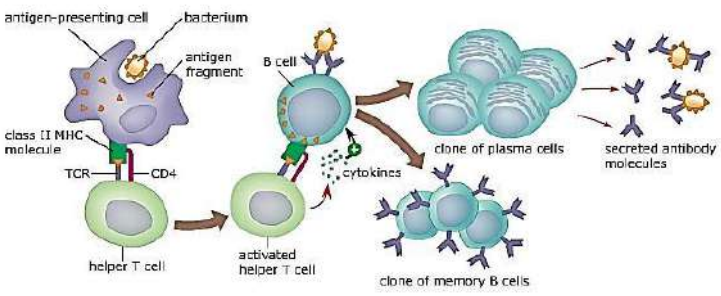
Interferons and Natural killer cells act as components of the second line of defense

Second: Acquired (specific or adaptive) immunity (The third line):

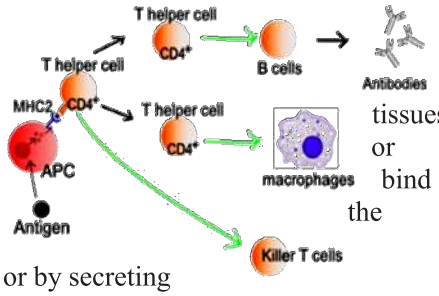
A) Humoral or antibody-mediated immunity:

This mechanism defends the body against antigens, pathogens present in the body fluids (blood plasma and lymph), by producing antibodies.

- The antibodies produced by B plasma cells will reach the blood circulation through the lymph, where they bind to the antigens found on the surface of the invading pathogens; this will activate the macrophages to re-engulf these antigens. This will continue for days or weeks.



B) Cellular or cell-mediated immunity:



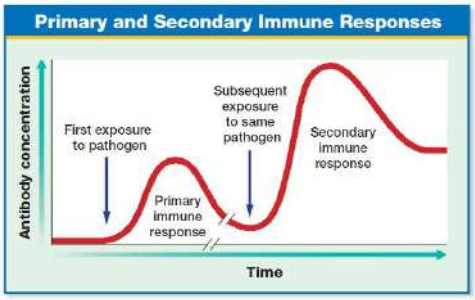
-The cytotoxic T cells can recognize foreign bodies by the help of the receptor CD8 found in its surface, whether these foreign bodies are transplanted tissues or the antigens of the microbes that enter the body or cancer cells and destroys them. When these cells bind to the antigen, they create pores in the membrane of the foreign body (microbe or cancer cells) by secreting a specific protein called **Perforin** (perforating protein), or by secreting lymphatic toxins that activates certain genes in the nucleus of the infected cell , leading to the destruction of the nucleus and its death.

-After destroying the antigens, the T suppressor cells (Ts) bind, with the help of the receptor CD8 found in its surface, bind to plasma cells, T helper cells and T cytotoxic cells. This binding will help it to secrete proteins called Lymphokines which suppress or inhibit the immune response or stop it, therefore, plasma cells will stop producing antibodies and many of the T helper cells and the activated T cytotoxic cells will die, but some of them will be stored in the lymphatic organs, where they stay ready to combat any similar infection when needed.

Stages of Acquired immunity

The first stage: primary immune response

When the immune system encounters a new pathogen, The B and the T cells will respond to the antigens of this pathogen and attack it until it is destroyed, this takes a longer time since these cells need time to multiply, and this is why the first response takes between five to ten days to reach its maximum productivity of B and T cells. During this time, the infection could be widespread and the symptoms of the disease appear.



The second stage:

Secondary immune response

If the same individual is infected by the same disease gain, the immune response will be very fast that the pathogen is destroyed before the appearance of the symptoms. The cells responsible for this secondary immune response are known as memory cells, which store information about the antigens fought by the immune system in the past.

Your body contains both memory B cells and memory T cells, both types of memory cells is produced during the primary immune response. B and T cells can survive only for few days, but memory cells can live for **tens** of years, and may survive till death.

During the second infection with the same pathogen, the memory cells respond to the pathogen once it enters the body, where they start dividing quickly to produce large amounts of the antibodies, and active T cells within short period of time.

Molecular Biology

Chapter (1)

Scientists thought at first that proteins are genetic material.
Because DNA contains only 4 kinds of nucleotides whereas proteins contain 20 kinds of amino acid, So proteins can produce more variation of different combinations than DNA.

Molecular Biology It is the study of molecular basis of inheritance (DNA molecule)

The Evidences, which prove that DNA is the genetic material

(1) Bacterial transformation

Griffith's experiment: (the bacterial transformation experiment)

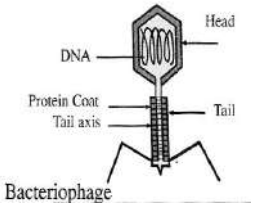
1.When Griffith injected mice with heat Killed virulent bacterial(S) together with living non virulent bacteria (R), some of the mice died.
2. He examined the dead mice, and found living virulent bacteria(S).
3. Griffith concluded that living non-virulent bacteria (R) absorbed genetic material of killed virulent bacteria (S) and transforming them to the virulent form "this phenomenon was named bacterial transformation"

Isolation of genetic material from pneumonia bacteria by Avery:
Avery and his colleagues isolated the material that causing genetic transformation from virulent bacteria to non virulent bacteria.

The crucial experiment
Deoxyribonuclease enzyme hydrolysis DNA completely but it does not affect the proteins or RNA so, when the transforming material was treated with this enzyme, the transformation did not occur indicating that DNA is the genetic material.

(2) Bacteriophage

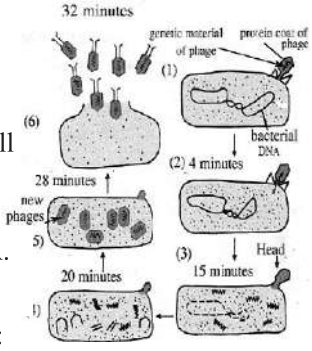
It is a type of virus infects bacteria only.



Structure of Bacteriophages:
1. A molecule of DNA inside a protein coat.
2. The coat extends like a tail to attach to bacterial cell wall.
3. DNA contains phosphorus but proteins contains sulphur.

Hershey and Chase's experiment
They labeled phage DNA with radio-active phosphorus and phage protein with radio active sulphur and allowed the phage to infect the bacterium cell

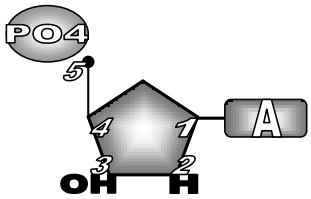
Observation:The radio-active phosphorus entered the bacterium cell but less than 3% of the phage radio active sulphur entered the bacterium cell



The conclusion:The genetic material of bacteria & phages are DNA.

(3) The quantity of DNA in cells

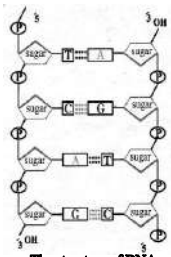
1. The amount of DNA in somatic and reproductive cells (gametes):
In eukaryotes, the amount of DNA is the same in all different somatic tissues
The somatic cells contain twice amount of DNA (2N) as much as (gametes)
but the amount of protein in the body cells varies from one tissue to another .
The amount of DNA is stable, while the RNA or proteins constantly being made and destroyed.



The structure of DNA

The building unit of DNA is a nucleotide.
The studding of Franklin by using X-rays diffraction
1. DNA molecule is twisted into a spiral or helix .
2. The sugar phosphate backbone is on the outside of the helix while the nitrogen bases on the inside of helix.
3. The diameter of the helix must be made of more than one strand of DNA.

Watson and Crick's model of DNA:
They were the first gave us the acceptable model of DNA molecule as follows:
1. DNA molecule consists of two strands like a ladder whereas the ladder sides being the sugar-phosphate backbones and the ladder rungs being the nitrogen base pairs.
2. Adenine paired to a thymine by two hydrogen bonds, but guanine paired to a cytosine by three hydrogen bonds.
3. The two DNA strands are always the same distance from one to another because each pair of bases consists of one single ring and one double ring and so all the rungs of the ladder are the same width.
4. The two strands of DNA molecule had to run in opposite direction of the other to form the most stable combination of hydrogen bonds between the two DNA strands.
5. DNA is twisted &each turn has ten pairs of nucleotides to form the spiral.
6. The two DNA strands have complementary base pairs so, each strand act as a template to produce the other.



The structure of DNA

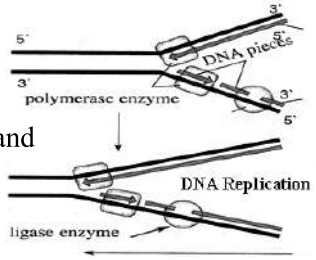
Enzymes of DNA Replication (duplication)

1) DNA - Helicase enzyme ✂

✂The two strands of the double helix must be separated, by breaking the hydrogen bonds between the nitrogenous bases.

2) DNA polymerase enzyme

- DNA polymerase enzyme adds the nucleotides one by one, in the direction 5' to 3'end of the new strand.
- Polymerase enzyme follows the helicase enzyme,So it work only in one direction from 5' to 3' end on the new strand



3) DNA ligase enzyme

🛠The short pieces are joined together by DNA ligase
🛠It moves at the direction from 5' to 3', end of the new strand at the opposite direction of Helicase enzyme and ligase enzyme.

DNA Repair

There are about 5000 purine nitrogen bases are lost each day from the DNA of human cell because heat breaks the covalent bonds linking them to deoxyribose sugar.
The reasons of damaged DNA:
1. The aquatic environment inside the cell.
2. The heat body.
3. Some chemicals.
4. The radiation.

🛠 The damage to the DNA causes changes in the genetic information, which will produce mutation but most of these changes are repaired by 20 kinds of DNA repair enzymes called "DNA ligases".
🛠 So there is not more than two or three stable changes accumulate in DNA cells each year.
🛠 The double helix of DNA keep the genetic stability of organisms because DNA molecule carries two copies of genetic information, one of these strands remains undamaged, the DNA ligases can use it as a template to replace a damaged area in its partner.
🛠 Some viruses show high rates of genetic change (mutation) because the genetic material of these viruses consists of a single RNA strand.

The plasmids small circular DNA molecules in prokaryotes

DNA in prokaryotes	DNA in eukaryotes
1- Surrounded by neuclear membrane	1- No neuclear membrane
2- In the form of Circle DNA	2- Its ends are not joined together
3- Not complexed with proteins.	3- Complexed with proteins
4- Attached to plasma membrane	4- Not attached to plasma membrane.
5- Have plasmids.	5- No plasmids.
6- Most of the genome is codon	6- About 70% codon &30%non codon
7- It is Replicated at the at the point that attach the plasma membra	7- It is Replicated at any point.
Transcription	Transcription
8- A single RNA polymerase transcribes the three types of RNA	8- Three different kinds of RNA polymerase transcribes the RNAs.
9- The transcription & translation takes place in cytoplasm at the same time .	9- The transcription in the nucleus, after that translation starts at the cytoplasm
10- e.g. E.coli bacteria	10- e.g. animal cells

Histone proteins	Non-histone proteins
• They have arginine & lysine amino acids • They are structural proteins. • The amino acids have R^+ groups, so they bend strongly to PO_4^{--} of DNA. They occur in enormous amounts in the chromatin of any cell.	• They are a heterogeneous group. • They are structural proteins, to keep the spatial organization of DNA Regulatory proteins, which determine the DNA code made enzymes, proteins and RNA or not.

The DNA molecule is wound around clusters of histone molecules forming a string of histone particles called **nucleosomes** which shortens the DNA molecule about 10 times. Strings of nucleosomes are arranged in large loops by structural non histone proteins to form condensed chromatin (Chromosomes).

The Genome: It is all the genes and DNA molecules in the body cell.
a. Many genes carry the information for making protein synthesis.
b. Some genes make the m RNA, t RNA and r RNA. (RNA synthesis).

Repetitive DNA
They may be codon to speed up the production of RNA and proteins.or non-coding DNA as In the fruit fly (drosophila), the nucleotide sequence AGAAG is repeated about 100,000 times in the middle of one chromosome.

Mutation is a sudden change in the nature of the heredity factor controlling certain character, which leads to change in these character in living organism

Kinds of Mutations

1. Gene mutations:

These are due to chemical changes in the arrangement of the nitrogen bases of the DNA molecule that lead to produce different enzyme, to form new trait. As a change from dominant to recessive state (e.g: sickle cell anemia)

2. Chromosomal mutation as Change in the number of chromosomes or Change in structure of the chromosome

Gamete mutation occurs in reproductive cells as Turner's syndrome and Klinefelter's syndrome.

Somatic mutation occurs in somatic cells.(organs)

The polyploidy:

It is a phenomenon in which the number of chromosomes are duplicated during the gamete formation of meiosis or during the Mitosis".

Polyploidy may occur in some liver and pancreas cells.

Origin of mutation

1) Spontaneous mutation. 2) Induced mutation

Chapter (2)

Molecular Biology

Types of proteins

Structural proteins They are the building materials in the living organisms Such as:

1. Actin and myosin that are found in muscles and other contractile systems.

2. Collagen that form connective ligaments.

3. Keratins They form protective covering tissues

Regulatory proteins They regulate the various processes and activities in the organisms such as:1.**Enzymes** regulate the chemical reactions

2. Antibodies that provide the body with the immunity against the infection.

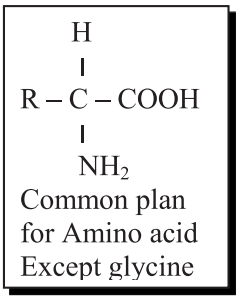
3**. hormones** that help the organsim to respond to the constantly changing in the internal and external environment.

4.Blood Proteins

Fibrinogen, Albomin & Golobulin.

The proteins are differences due to:

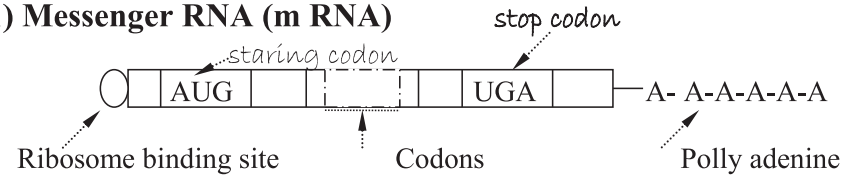
1. Numbers, kind, and the arrangement of amino acids in each polymer.
2. The number of polymers that form the proteins.
3. The hydrogen bonds that give the protein molecule its special shape.



Common plan for Amino acid Except glycine

The types of RNA: (m RNA)- (r RNA)- (t RNA)

1) Messenger RNA (m RNA)



Its function is the carrying the code from DNA to ribosome, where it is translated into a particular sequence of amino acids in a polypeptide.

A Ribosome site is a sequence of nucleotides that binds to ribosome, the first starting codon (AUG) is present in corrected position on ribosome for translation.

At the other end of m RNA molecule there is a polly adenine tail composed of up to 200 adenosine.To protect m RNA from breakdown by enzyme in the cytoplasm.

The transcription of RNA from DNA

➢The transcription is the process in which a particular sequence of nucleotides in one strand of DNA is transcribed to a complementary sequence of nucleotides in m RNA".

➢by **RNA polymerase enzyme** and moves along the promoter of (DNA) from 5` to 3` direction on the new strand.

2) Ribosomal RNA (rRNA)

Its function is translation of the codons on mRNA into amino acids and join them together into polypeptide chain.

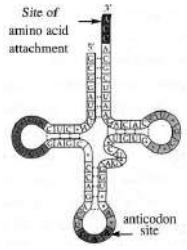
The structure of ribosomes in eukaryotes:

It consists of 70 kinds of polypeptides and two subunits, one large and the other is smaller which are joined together during proteins synthesis only.

The Formation of Ribosomal subunits:

In eukaryotes several hundred thousand of ribosomes are made per hour because DNA contains about 600 copies of genes for the transcription of 4 different kinds of r RNA.

3) Transfer RNA: (t RNA)



t RNA is transcribed from grouped of 7 to 8 tRNA genes in DNA.

The structure of t RNA

All t RNA molecules have the same general shape

There are two important sites on t RNA

at the 3' end.(CCA) is the attachment site of amino acids

The other site is the anticodon site, which paired with suitable m RNA codon

The function of t RNA:

It carries the amino acid into m RNA & ribosome during the growing polypeptide chain.

The Genetic Code

If the four nucleotides arranged in triplets, they produce $(4)^3$ =64 different codes

Each codon represent one amino acid ,but each amino acid has more than one codon.

The start codon om m RNA is (AUG) (methionine amino acid)

The three stop codons (UAG,UAG and UAA) which terminate protein synthesis.

The genetic code is nearly universal, the same codons represent the same amino acids in all living organism and act as evidence to prove the evolution.

Steps of Protein Synthesis

I. Initiation. **II. Elongation of polypeptide chain.** **III. Termination**

The releasing factor is a special protein, binds to the stop codon on the mRNA & causes the mRNA to leave the ribosome and the ribosomal subunits separate.

Polyribosome or polysome. It is mRNA molecule which has several to over 100 ribosomes attached to it and transcribing its codons as they move along.

Molecular Technology

It is possible now to isolate a designed gene and grow millions of copies of it in the cells of bacteria or yeasts.
It is possible to analyze these copies to:
a. determine the nucleotide sequence in the gene.
b. compare the structures of different genes in the same organism or in different organisms so, the sequence of nucleotide determine the sequence of amino acids in the corresponding proteins.
It is possible now to make DNA by order.
In 1979 Khorana introduced an artificial gene into a culture of bacteria.

The Genetic engineering techniques

1. Nucleic acid hybridization. (hybridization techniques)
If DNA is heated to 100◦C, the hydrogen bonds between the nitrogenous bases will be broken and the two strands of the double helix separate
When the temperature is lowered, the unstable single strandeds of DNA tends to be double helix once again by sticking it self to another single strand to form a double helix.
The degree of annealing between any two strands can be measured by the required temperature to separate them again so, if the degree of annealing is high, the amount of heat required to separate them will be high.
The production of hybrid DNA (mixed double helices):
1. Mixing nucleic acids (DNA or RNA) from two different sources & heating them to 100°C.
2. When the mixture is allowed to cool, some of original helices will reform, and many new hybrid double helix will form, each hybrid made up of one strand from each source.

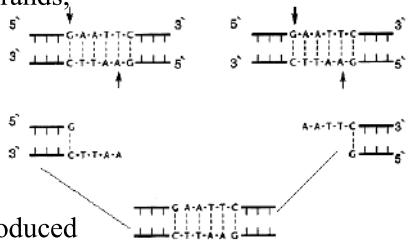
Uses of DNA Hybridization
1) Detect the presence of a particular gene & its amount (copies) in the cell
a. By using radioactive single strand that complementary to one strand of the gene.
b. Mixing the radioactive strand with the unknown sample, the concentration of the gene in the sample is indicated by the rate of the formation of radioactive double helices, which consists of one radioactive strand and one strand of the gene in the unknown sample.
(2) Determine the evolutionary relationship between different species.
If the evolutionary relationship between the two species is closer, the degree of hybridization between them will be greater because the sequence of their DNA is more similar.

2. Bacterial Restriction Enzymes

The restriction endonucleases a certain kind of E-coli don't destroy its own DNA. Because each species of bacteria has "modification enzyme" which recognize the same DNA sequences that are attacked by its restriction enzyme and attach methyl groups (CH_3) to the recognization site. These groups protect DNA from the restriction endonucleases

The properties of Restriction Endonucleases:

1) They are spread in micro-organisms such as Bacteria.
2) There are about 250 types are isolated from different bacterial strains
3) Each enzyme can recognize a specific sequence of 4 to 7 nucleotides.
4) Snips the DNA at or near recognization site.
5) Each restriction enzyme will cleave DNA from any source (virus, bacteria, plant or animal) DNA contains one or more copies of its specific recognization site.
6) They work in the direction from 3` to 5` of each DNA strands.



Uses of Restriction Endonucleases enzymes:

1. Cut DNA into pieces with two inclined sticky ends
Staggered cuts (inclined) because the double helix is left with two single strand ends.
"Sticky ends" because the nitrogen bases of each end can be paired with other single stranded end which produced by the same restriction.
2. Connect a specific section of DNA (a gene) into another DNA molecule or plasmid
3. Then the cut ends can be joined into a single strand by DNA ligase.

3. Cloning DNA sequences.

Cloning DNA sequences is the production of several identical copies of a gene by splicing it to plasmid that carry it into a bacterial cell.

1) Attach a foreign gene into a plasmid by treating the plasmid and the gene with the same restriction endonuclease to create sticky ends and join by DNA ligase.
2) Add the plasmid which carry gene to a culture of bacteria or yeast cells that have been treated to make them more permeable to DNA.
4) The cells grow and divide and replicate the plasmid with their own genome.
5) Break down the cells and treat the recovered plasmids with the same restriction endonuclease
6) Release the cloned gene from the plasmid by differential centrifugation.

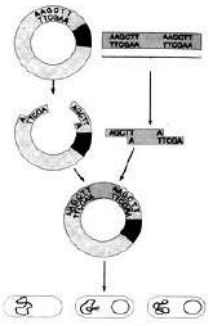
Two Ways for obtaining DNA sequences for cloning DNA

1)The first way

By treat all the genome with restriction endonuclease to produce million of DNA pieces.
b) These DNA pieces are attached to plasmids or phages and cloned.
c) by selection techniques the desired DNA sequences isolate.

2)The second way (the better way)

a) By isolation the m RNA from a genome of an active cell as cells in pancreas produce insulin or the red blood cells produce hemoglobin because these cells produce a great amount of m RNA carrying the message of protein.



DNA Cloning

The isolated mRNA is used as a template to make DNA, by reverse transcriptase enzyme (produced by viruses with RNA genomes) to produce a single strand of DNA
c) The single strand of DNA can be duplicated into double helix by DNA polymerase enzyme.
The polymerase chain reaction (PCR) (Cloning DNA sequences by PCR)
This machine uses tag polymerase enzyme, which works, at high temperatures to make many thousand copies of DNA in few minutes.

4. Recombinant DNA.

It is the introduction of DNA from one organisms into cells of another.
The Practical application of recombinant DNA technology
1) The production of useful proteins such as human insulin, and the interferon.
The interferon is a protein that interfere the replication of viruses genome .
Recombinant DNA technology in agricultural researchers
1) To produce crop plants for resistance for herbicides and diseases.
2) To produce of plants have the ability to fixing the nitrogen gas in their roots
Some dreams are coming true much faster than we might expect.
(1) The introduction of ruby- eyes gene of fruit flies into another strain with brown eyes.
(2) The introduction a growth hormone gene from rate or human into small mice.
(3) The introduction of genes carry some characters into petunia and tobacco cells.
The Danger of genetic engineering
Suppose a strain of bacteria with a gene for a dangerous toxin were let loose on the world But the chance of this happing is slight because the bacteria used in recombinant DNA experiments are ***Escherichia Coli*** which live in the human intestine, they can not longer survive outside the test tube in the laboratory.

The human Genome

Scientists discovered that there is about 60000 - 80000 genes in the human body which exist in 23 pairs of chromosomes which are arranged according to their sizes from number (1) to number (23), the chromosome (X) is not part of this arrangement.

The Gene	Location
Finger print	Chromosome no. (8)
Blood group	Chromosome no. (9)
Insulin gene & Haemoglobin gene	Chromosome no. (11)
Colour blindness& Haemophilia	Chromosome (X)

The uses of the human genome

1) Identifying the genes which cause the rare and common hereditary diseases.
2) Identifying the genes which cause disability of organs to perform their activities.
3) Preparing drugs without side effects in the future
4) Studying the evolution of living organisms by comparing the human genome with genes of the other living organisms.
5) Improving the offsprings by identifying the defected genes of the fetus before it is born and how to be treated (gene therapy).